Fig. 3. Piece of cast larval skin of *Hornia gigantea.*
Fig. 4. Pupa of *Hornia gigantea.*
Fig. 5. ♂ type of *Hornia gigantea.*
Fig. 6. ♀ type of *Hornia gigantea.*
Fig. 7. Triungulin found on leg of the bee, *Anthophora occidentalis.*
Fig. 8. Head of ♂ cotype of *Hornia gigantea.*
Fig. 9. Maxillary palpus of ♂ type of *Hornia gigantea.*
Fig. 10. Fore tarsal claw of ♂ type of *Hornia gigantea.*
Fig. 11. Antenna of ♂ *Hornia gigantea.*

Plate II. All figures except Fig. 15 reduced.

Fig. 12. Bird's eye view of a colony of the larvae of *Amblychila cylindriformis,* on the sloping bank of White Woman Creek, Greeley County, Kansas, August, 1910. The pen-knife placed in the figure for comparison, is 3⅝ inches long. The shaded holes are closed.
Fig. 13. Vertical view of a colony of the larvae of *Amblychila cylindriformis,* Wallace County, Kansas, August, 1910.
Fig. 14. Vertical section through a tunnel of the larva of *Amblychila cylindriformis,* Wallace County, Kansas, August, 1910.
Fig. 15. Dorsal and lateral view of a mud nest of *Heterocerus* sp.
Fig. 16. Vertical section through a tunnel of the larva of *Amblychila cylindriformis,* Morton County, Kansas, August, 1911. Photo by Lovejoy.

The Species-status and the Species-concept.

By Charles H. T. Townsend, Lima, Peru.

The question as to what constitutes a species is as old as the science of biology. Nevertheless it is not yet satisfactorily answered. In the case of certain groups of plants and animals the answer is simple. These groups belong to old stocks that have long since passed through their period of evolutional activity, are no longer undergoing extensive variation and specialization, and have lost at least in great part the transitional forms that arose during the process of their evolution. But when we attempt to define a species in younger groups which are still undergoing extensive evolution, or have but recently reached the climax of multiform development, the answer is not simple. Examples of such groups are furnished by the Muscoidea among insects and by the Compositae among

plants. The difficulty to be overcome in these groups arises from the presence of a large number of the transitional forms and individuals that are always produced during the evolution of stocks. What is to be done in such case? It is clear that what suffices to meet the requirements of the one case will not meet the quite distinct requirements of the other. The species-concept must therefore be modified to such extent as is necessary for adapting it to the requirements of each case.

It has long been held that a species comprises all individuals whose interbreeding will produce fertile offspring. This can not now be accepted. Plants, insects, and even mammals, which the majority of biologists will agree are entitled to specific recognition, possess this power. We have only to recall the plants which have been successfully hybridized within recent years and insect species which have mated and produce fertile progeny. It is quite possible to secure fertile offspring from the union of certain distinct but closely allied species of flies, butterflies and beetles whose external sexual organs admit of mating. Instances of hybrid insect races are on record. It is not within the limits of this article to cite cases, but the records show it to be practically beyond question that in certain instances the spermatozoa of one species have the power to fertilize the ova of another and produce therefrom fertile individuals. Other definitions of species so far given, aside from the above, also fail to apply in young stocks.

The keynote of all biological investigative work is to verify and record faithfully the results of one's investigations. Such results form a sure basis for further investigations. It is certain that all systematists do not yet fully realize the significance of some of the unchallenged results so far obtained. As a profitable though *outré* illustration, true nevertheless to living conditions, we may imagine an immense extent of fertile land surface covered with a varied and teeming flora and fauna still more or less in process of evolution and subjected to all the varied combinations of conditions that will support life. We may further imagine for the moment that we are not only intimately acquainted with each of the practically innumerable

forms and individuals that compose this flora and fauna, but also that we are able to follow out in sequence all the lines of their issue through a period of a few millions of years. What would be the result of our observations in such case? It is certain that we would see many forms drop out, we would see many new ones arise, we would see great variations in some and less variation in others, we would see some persist in nearly their original form; but most important of all from a taxonomic and phylogenetic point of view we would witness the production of hordes and multitudes of transitional individuals and forms that would quite effectually clog any known system of classification, were they assembled with the typical forms in their entirety. At any given time in the production of these transitionals, the living residue would show plainer lines of separation, but specific and other limitations among them would not be amenable to current methods. These conditions are actually exemplified today in certain young stocks inhabiting favored regions. There are stocks of Muscoidea and Compositae in the Andean montanya whose progenitors have almost certainly been in that region or an equally favored contiguous area for the past two or three millions of years, and their living forms in many instances exemplify the conditions just mentioned. While this region is probably the most highly favored in this respect in the world, it is certain that many other regions exist both in and out of the tropics where similar conditions are exemplified by these and other young stocks. Many muscoid groups exhibit today in various parts of the world so many transitional forms and individuals that we have long been unable conveniently to classify them. Yet we know that these groups have already lost many of the transitional forms, together with immense hosts of transitional individuals, that arose during their evolution up to the present time. What conclusion can we draw from these facts? Simply that there exist in nature, among groups of young stocks undergoing active evolution, no well defined or fixed species limits; but that there certainly exist aggregations of individuals observing some general specific bounds which suffice to meet the

requirements put upon them by varying natural conditions, or failing to meet them perish.

This phase of biologic inquiry can, in a measure, be likened to infinity. In theory infinity is incomprehensible, but we comprehend parts of it in practice. Theoretically there is almost no limit to the morphologic variety that life may assume, but practically it is limited to such morphology as we know or can base on that which is known. When we come to consider the limits of species we find that in practice as well as theory they have among themselves no natural sequential or genetic limits, and often no residue limits at any given point in their development, but nevertheless they certainly exist under both conditions, however obscured may be their limits. Were we able to restore and gather together all the individuals that have arisen during the evolution of species on this globe up to the present day, we would find few or no places where we could draw natural lines of division between categories of individuals. In practice, however, among the living residue of today, the limits of natural species are such as they make for themselves. It remains for us to find these limits out. The illustrations which I have used may be judged as forced and far-fetched, but they are true to nature and therefore their forcefulness is the more serviceable.

Variation even among existing forms has almost no limits. The number of possible combinations of the characters of organisms, past, present and future, is almost infinity itself. The best that we can do in the present with the great plastic mass of living young forms is to divide it as conveniently as we may, conforming to phylogenetic lines as closely as it is possible to interpret them. It is certain that in highly specialized and comparatively recent groups we gain simplicity and conciseness as we descend in the taxonomic scale and diminish the scope of our units of treatment. This applies not only to groups but to genera, subgenera, species, subspecies and races. It arises from the contraction of taxonomic values obtaining in such stocks. We need to apply a restricted species-concept in dealing with these forms, as well as employ restricted groups and categories in general.

It appears possible to define a species as an aggregation of individuals which in the majority of cases breed together under normal conditions and produce fertile offspring. This seems true, but it is incapable of application with immediate final results in the case of young stocks. The chief difficulty lies in determining what are the limits of the normal fertile variants of species in such stocks. Long series of observations must be carried out to establish the normal self-observed limits of such species in nature. This labor must here often follow instead of preceding a working species-concept, because we need names under which to record our results during the carrying out of the necessary investigations. By the normal self-observed limits of species in nature is meant their limits in the long run, divested of exceptions and vacillations. It is useless to attempt to solve such problems merely by the study of dead material. The living phases, functions and environment of the material must be studied as well, and that diligently.

Thus it is safe to say that each species will have to be worked out eventually on its own merits and standing. As this cannot be done at once, our working concept must be a tentative one that will apply now for such cases. It must be plastic, but of such nature that it will cause no future confusion or perversion of recorded facts that belong with it. How shall we gain the practicable end of a working species-concept for dealing with the forms exhibited by young stocks? It seems that the best way to do this, because the simplest and most thoroughly guarded against error, is to bestow a name upon every form at all abundant in individuals that can be distinguished as different from other forms—every form that we can sense and characterize as a different form, regardless of the presence or absence of transitional individuals, of interbreeding limits, or of other than an approximate constancy of characters—and to consider that form as a tentative restricted species. Such plan will not interfere with the subsequent proper tabulation of forms as subspecies and races, when our knowledge is sufficiently complete to warrant it.

Individual-occurrences should not be confused with form-

occurrences. Transitional individuals or means of variation occur linking together extremes of variation that seem to have been derived from the same specific stock. The extremes need names if they are abundant enough in individuals to constitute form-occurrences; so do the means if they are similarly abundant and capable of characterization. But isolated transitionals and those of slight differentiation may be recorded by noting their degree of divergence from one or other of the named forms. In this manner exact and concise records are preserved of each individual form and its variations. Such records are indispensable in both present and future work. These forms are in many cases potential if not actual species, and all of them need to be recorded now.

The lumping of recognizable forms under one name is a most serious taxonomic offense, unless in each case the precise limits of divergence from the typical form are shown. An immense number of muscoid names has been thrown into the synonymy within recent years, not only in America but also especially in Europe. No doubt some of these belong there, but it is very probable that many might be profitably employed for the recognition of localized and various transitional forms among these highly versatile flies.

The foregoing remarks at least throw some light on what may be termed the species-status in nature, and it is believed that they demonstrate the need of a modified species-concept for application in young stocks. It will be useful to summarize the main points.

Summary.

1. In old stocks, species have normal values and well defined limits, because evolution has become inactive in those stocks and maturity has been attained by the forms.

2. In young stocks, the contraction of taxonomic values due to youth restricts the scope of species, and the presence of many transitionals due to active evolution obscures their limits.

3. Therefore the species-status is not uniform in old and young stocks, and the species-concept must be modified to agree with it.

4. Though transitionals obscure limiting lines in dead material, species exist in young stocks and the actual limits of each are such as it makes for itself by the general interbreeding of its constituents under normal conditions.

5. The normal self-observed limits of species in nature among young stocks must be worked out on the merits of each case by the study of living material through all its stages with relation to its environment.

6. As a basis for this work all recognizable forms in young stocks must be described, named and regarded as tentative species until their status is finally determined.

7. All recognizable forms in young stocks demand a name and final place in the taxonomic system down to race rank, and none should be lost sight of by lumping of names.

8. Isolated or aberrant transitionals need no distinctive name, but as a matter of record they should be descriptively differentiated from that form which they most closely approach.

9. It follows that the describing and naming of forms in young stocks should be based on as large series as possible.

Notes on the Thoracic Sclerites of Winged Insects.*

By G. C. Crampton, Ph.D.

(Plate III.)

As used by most anatomists, the term *dorsum* is applied to the entire upper or dorsal surface of an insect's body; the entire side, or lateral portion of the body is termed the *latus;* and the entire lower or ventral surface is termed the *venter.* To avoid confusion, these terms should be used in this sense alone.

The entire dorsal region of each segment (i. e. the more membranous, as well as the more strongly chitinized portions of the body wall) is termed the *tergum,* or *notum;* the entire lateral region of each segment is termed the *pleuron* (both flanks being termed the *pleura*); and the entire ventral region

*Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.